TITLE OF INVENTION

STANDARD ATTACHMENT FITTINGS FOR WIRE ROPE AND CHAIN ENHANCED TO ALSO PERFORM LOAD WEIGHING FUNCTIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

Application Numbers

36,184
498,022

STATEMENT REGARDING FEDERALLY SPONSERED RESEARCH OR DEVELOPMENT

Not Applicable

REFERENCE TO A MICROFICHE APPENDIX

Not Applicable

BACKGROUND OF THE INVENTION

The present invention relates in general to standard attachment fittings for wire rope and chain (WR&C) and more particularly, such fittings that are enhanced with weigh sensing capability to also perform load weighing functions.

There are a number of devices (some patented) that provide weighing capability to WR&C load lifting/support or pulling assemblies such as those often found in overhead crane systems. However, with regard to certain aspects of safety complications, weighing

device/assembly complexity and component cost, these prior art devices can be subject to specific problems.

A typical prior art weighing device such as that outlined in U.S. Pat's to Khachaturian et al., No. 5,429,007 and Khachaturian et al. No. 5,589,646 for WR&C lifting/support or pulling applications is a component within the said assembly that is required to lift/support or pull in addition to weighing a load. In order to ensure safety, and functionality consistent with the original tensile and impact loading specifications of the associated WR&C fittings, prior art weighing devices must be tested to meet such load performance specifications.

Such prior art weighing devices are additional lifting component(s) within a lifting/support or pulling assembly that subsequently require additional attachment fitting(s) increasing assembly complexity, cost and the possibility of assembly failure.

Such prior art weighing devices typically require a "thin section" in the body of the load sensor to focus load weight in order to achieve load weight measurement accuracy. This thin section reduces structural integrity of the weighing device.

BRIEF SUMMARY OF THE INVENTION

Standard attachment fittings for wire rope and chain (WR&C) enhanced with weigh sensing capability to also perform load weighing functions. A membrane thin strain gauge element is affixed to the body of a said fitting in any one of a number of possible positions. Accurate load weight measurements are achieved from the focused linear load strain that results in the fitting when a typical tensile or non-typical compressive load (in the case of an eye bolt) is applied. The load weight measurements are transmitted through wiring or a wireless remote system to a suitably positioned readout display.

It is an object of the present invention to enhance standard attachment fittings for WR&C used in lifting/support or pulling applications to perform load weighing functions without modification to their basic design configuration whilst maintaining their original application functionality.

A feature of the present invention is that it provides the said enhancement without introducing a separate weigh scale unit that is required to lift/support the load in addition to

providing weighing functionality. Therefore additional testing of the strain gauge to ensure that it meets the established WR&C fitting tensile and shock load performance specifications is not required to ensure safety.

Another feature of the present invention is that it allows a reduction in the number of said WR&C load supporting fitting assembly components thus reducing potential risk of assembly failure, reducing assembly complexity and reducing assembly cost.

Another feature of the present invention is that the need for a "thin section" in the WR&C fitting body to focus load weight in order to achieve load weight measurement accuracy is not required. The unmodified existing shape of the WR&C fitting produces focused linear load strain at specific determinable points on the fitting body permitting accurate load weight measurement. The elimination of the need for a weaker thin section further enhances safety.

Another feature of the present invention is its ability to retain said fitting assembly overload readings for viewing on a readout display to warn the use of potential permanent fitting distortion and further enhance safety.

Another feature of the present invention is that, when shackle fittings are used, the weigh sensing strain gauge element position will not interfere with the attachment and removal of the shackle pin.

Another feature of the present invention is that because of the reduction of WR&C load supporting fitting assembly components, the assembly length can be reduced thereby increasing the available load clearance from the floor in applications such as those involving overhead crane use.

DESCRIPTION OF THE DRAWINGS

Fig. **1a** is a front view of a weigh-sensed shackle fitting according to a preferred embodiment of the present invention.

Fig. **1b** is a front view of a weigh-sensed shackle fitting according to a second preferred embodiment of the present invention.

Fig. **2** is a front view of a likely conventional wire rope and chain lifting/support or pulling assembly with weigh scale.

Fig. **3** is a front view of a likely weigh-sensed wire rope and chain lifting/support or pulling assembly according to the present invention.

Fig. **4a** is a front view of a weigh-sensed eye bolt fitting according to a third preferred embodiment of the present invention.

Fig. **4b** is a front view of a weigh-sensed eye bolt fitting according to a fourth preferred embodiment of the present invention.

Fig. **4c** is a front view of a weigh-sensed eye bolt fitting according to a fifth preferred embodiment of the present invention.

Fig. **5a** is a front view of one of a number of weigh-sensed eye bolt and wire rope assemblies under tension and affixed to a platform or vessel according to the present invention.

Fig. **5b** is a front view of one of a number of weigh-sensed eye bolts under compression and affixed to a platform or vessel according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figs. **1a** and **1b** illustrate a standard pin and shackle assembly for wire rope and chain (WR&C) lifting/support or pulling applications that is enhanced with weigh sensing capability to also perform load weighing functions according to a first and second preferred embodiment of the present invention. The said weigh-sensed standard pin and shackle assembly **10** is comprised of a shackle pin **12** affixed to a shackle body **11.** A membrane thin strain gauge element **14** configured as a Wheatstone bridge is also affixed to the shackle body **11** at a predetermined position tested for the production of focused linear load strain readings when subjected to tensile loading in typical applications. The strain gauge element **14** can be connected by wiring **15** to a suitably positioned commercial electronic readout display unit or else configured to provide load readings to the said display through a wireless remote system. The wiring **15** (when used) and the strain gauge element **14** are protected by a highly resilient impact resistant material **27**. The wiring **15** is connected to a stretchable cable and end fittings (not shown) to protect the hook-up from inadvertent disconnection and provide a quick and easy to use interconnect between the strain gauge element **14** and a readout display unit.

Other configurations and application functionality of standard WR&C fittings enhanced with weigh sensing capability are also possible.

Fig. **2** illustrates a likely conventional WR&C lifting/support assembly utilizing an "in-line" separate weigh scale as a component required to both weigh and lift/support a load. The said assembly **16** is comprised of two standard shackle assemblies **18** (each comprised of a shackle body **11** or **11b** and shackle pin **12**), a hook assembly **20** (comprised of a hook body **22** and swivel eye **21**), weigh scale **19** and wire rope or chain **17**.

Fig. **3** illustrates a likely weigh-sensed WR&C lifting/support or pulling assembly according to the present invention wherein the conventional weigh scale is replaced with a membrane thin strain gauge element. The said assembly **23** is comprised of one weigh-sensed standard shackle assembly **10** (comprised of a shackle pin **12** and shackle body **11** with affixed strain gauge element **14** and, in the case of a non-wireless remote system, wiring **15**), a hook assembly **20** (comprised of a hook body **22** and swivel eye **21**) and wire rope or chain **17**. As a component in the said assembly, the strain gauge element **14** only provides weighing functionality and is not required to lift/support the weight of a load.

Figs. **4a, 4b** and **4c** illustrate a standard eye bolt for WR&C lifting/support or pulling applications that is enhanced with weigh sensing capability to also perform load weighing functions according to a third, fourth and fifth preferred embodiment of the present invention respectively. The said weigh-sensed eye bolt assembly **24** is comprised of an eye bolt body **25** and membrane thin strain gauge element **14**. Strain gauge element **14** is configured as a Wheatstone bridge and affixed to eye bolt body **25** at a predetermined position tested for the production of focused linear load strain readings when subjected to tensile or compression loading. The strain gauge element **14** can be connected to and used with a commercial electronic readout display in the same manner outlined for the weigh-sensed pin and shackle assembly.

Figs. **5a** and **5b** illustrate functional applications of the said weigh-sensed eye bolt assembly **24** subjected to typical tensile and non-typical compression loading respectively. In a tension loading application, an object or other matter could be placed in a vessel or on a platform **26** or the like and lifted with a number of eye bolt assemblies to obtain accurate weight readings. In a compression loading application, an object or other matter could be

placed in a vessel or on a platform **26** or the like and supported with a number of weigh-sensed eye bolt assemblies to obtain accurate weight readings. In the case of non-typical compression loading of the weigh-sensed eye bolt **24**, focused linear strain still results.

The present invention, illustrated in Figs. **1a, 1b, 3, 4a, 4b, 4c, 5a** and **5b**, is well suited for any WR&C lifting/support or pulling application in which accurate load weighing capability, enhanced safety, reduced cost and increased simplicity using standard WR&C fittings are also required. Although standard shackle and eye bolt fittings have been used in describing the present invention, it will be apparent to those skilled in the area that other WR&C fittings such as hooks and master links are also applicable. As a result of their basic standard shapes, such fittings have determinable positions on their surfaces (as shown in Figs. **1a, 1b, 4a, 4b** and **4c**) that are subject to focused linear strain when used in the said applications. In the case of shackle fittings, placement of the strain gauge element **14** on the shackle body **11** ensures that the strain gauge **14** does not interfere with the shackle pin **12** during assembly and disassembly of the shackle assembly **10** with the rest of the WR&C fitting assembly **23**. Focused linear strain results in accurate load weight measurement making the said WR&C fittings very suitable in configuration for load weighing functions (such as those shown in Figs. **3, 5a** and **5b**) in addition to all of the original intended functions of such fittings.

Further to this, the focused linear strain that results from loading the said WR&C fittings eliminates the need to introduce a "thin section" in the fitting body or load sensor to focus load weight within this weakened area in order to achieve load weight measurement accuracy. By eliminating fitting body modifications and the normally required thin section common to load cell construction, the structural integrity and original functionality of the said WR&C fittings is maintained.

The stated utilization of standard WR&C fittings to also encompass the function of measuring load strain eliminates the requirement for a separate weigh scale unit **19** and any subsequent extra weigh scale unit attachment fitting(s) such as **11b** to be used within a weigh-sensed WR&C lifting/support or pulling assembly **23**. Fewer lifting/support components are required. The issue of required testing and certification of a separate weigh scale **19** (that must lift/support a load in addition to its weighing function) to meet required tensile and shock loading strength specifications is also eliminated.

Further, the present invention also enables overload indication and the monitoring of the condition of standard WR&C fittings as well as the chain and wire rope within the weigh-sensed assembly **23**. If excessive load weight is applied to the weigh-sensed assembly **23**, a load reading relating to any permanent distortion of the fitting(s), wire rope or chain will not only be shown on a suitably positioned readout display, but will be retained on the readout display after the excessive load has been removed. In this way, the present invention enables a warning to the operator of overload, permanent distortion and possible subsequent failure of the fitting(s), wire, rope or chain. This enhances safety, particularly in critical overhead lifting applications using these types of fitting assemblies.

The standard fitting(s) already required on a typical WR&C lifting/support or pulling assembly also becomes the weigh scale system with the strain gauge **14** properly installed upon the fitting assembly as shown in Fig. **3**. Therefore, the cost involved is only for the weigh sensing enhancement of the required fitting(s) rather than a separate weigh scale unit and associated attachment fitting(s).